Space Weather Technical Forecast

Issued on Thursday, 10 November 2022 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2/Minor to Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low with only one significant C-class flare, a C4.3 from the vicinity of AR3140 at 09/2005UTC. There are six numbered and one unnumbered group on the visible disc. AR3141 (Eko/Beta-Gamma) is the most complex region on the disc, but also appears relatively inactive. AR3140 (Hsx/Alpha) which produced the recent C-class flare has only evolved slowly. The remaining regions are either small, weak or fading. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, has been at slow speeds throughout, declining from 380km/s to 330km/s. Density was below average through the period. Total magnetic field strength (IMF) has been weak. The north-south component, Bz, started weakly negative, but switched to be weakly positive from around 09/1000UTC. Phi angle has been predominately positive (away from the Sun), but briefly rotated into the negative polarity between 09/0830-1000UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 was at background to moderate levels, with a peak of 471pfu at 09/1850UTC. Electron fluence levels are currently at background levels, with a slight upward trend to a peak value of 1.61e7 integrated pfu observed at 09/2400 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be Low or Very Low, with an increasing chance of isolated Moderate activity, due to the development of regions on the visible disc and returning regions rotating onto the disc from the far side.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast for the next four days. Solar wind speeds are expected to be mainly at background, with a low risk of connection to the high speed streams from either coronal hole 41 or 43, most likely on 10 or 11 November. Geomagnetic activity is expected to be mainly Quiet to Unsettled, but with a slight chance of Active or G1/Minor Storms on 10 or 11 November, should the Earth connect with either of the coronal hole high speed streams.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to remain at background levels. High energy electron flux (greater than 2MeV) is expected to be at background to moderate levels, with a slight risk of reaching the high threshold on diurnal peaks. Electron fluence values expected to remain below the Active (1e8 integrated pfu) threshold.

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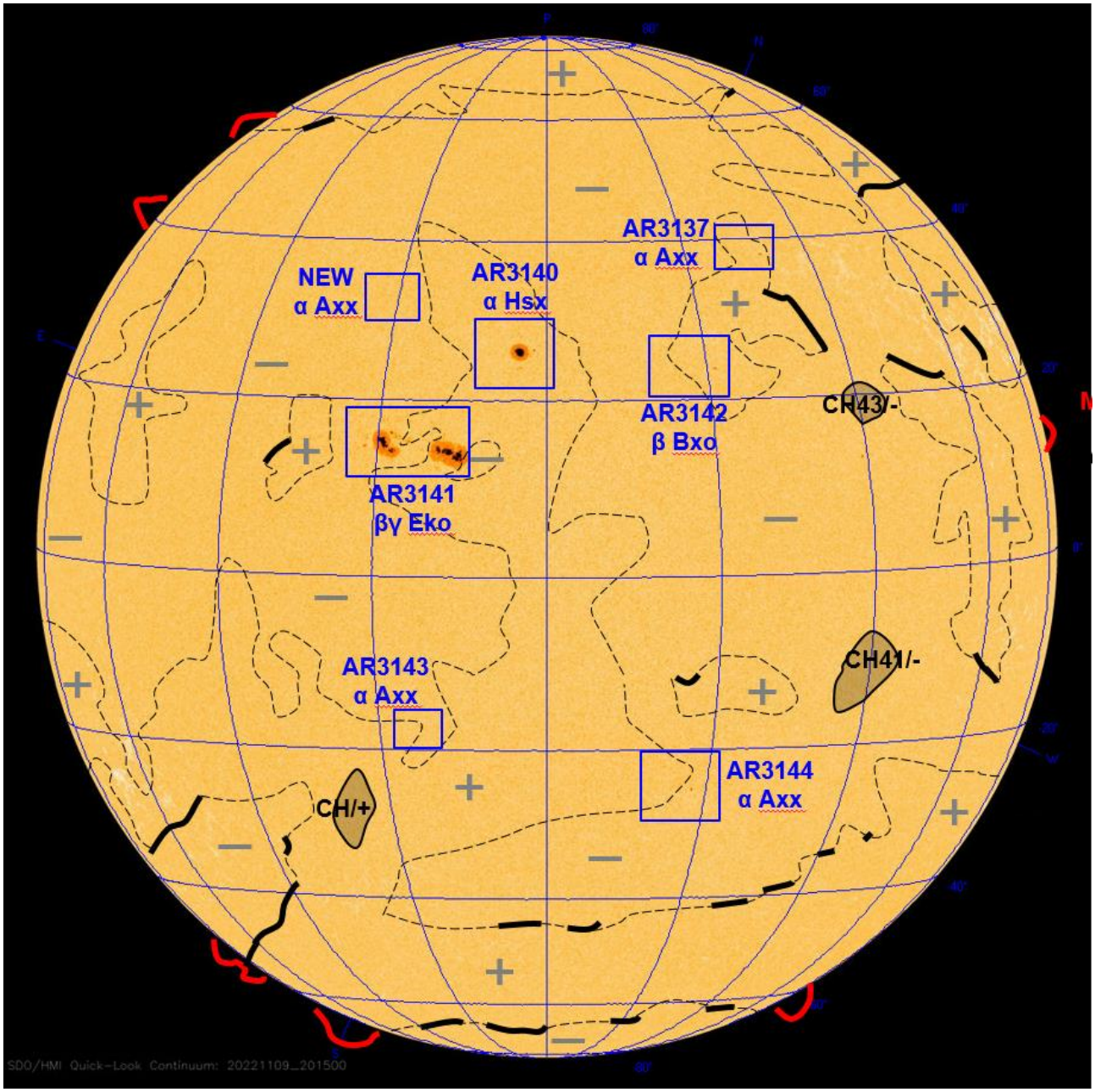
Figure 1. Solar Analysis Valid 09/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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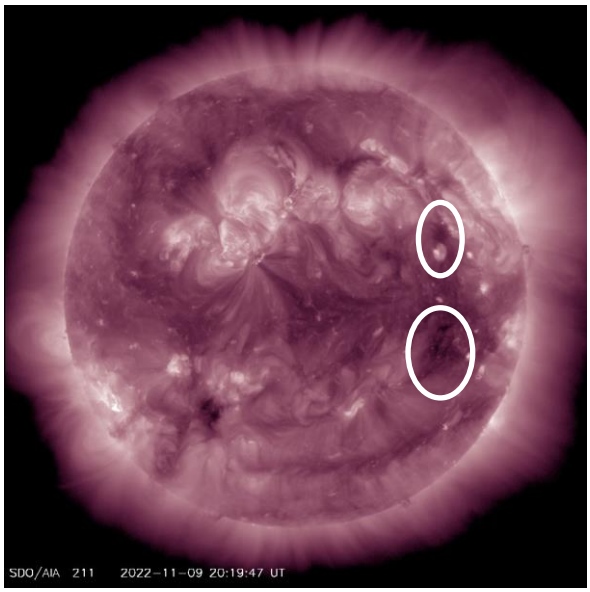
Geomagnetic Storms:
No Earth-directed CMEs are forecast.

Solar winds are currently at background values, with a chance that coronal hole 42 could connect weakly with Earth at times. Coronal holes 41 and 43 could also connect with Earth, with this most likely on 10 or 11 November, although due to the appearance of the holes on SDO imagery, any connection is likely to be weak with speeds in the region of 400-500km/s. Any geomagnetic effects are also likely to be muted, as negative coronal holes are unfavoured for strong connections close to the September equinox.

Geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a slight chance of Active intervals, and a very slight chance of G1/Minor Storms due to weak coronal hole connections on 10 or 11 November.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO AIA 211 imagery of the solar disc, showing the weakness of the coronal holes in the western hemisphere (circled)



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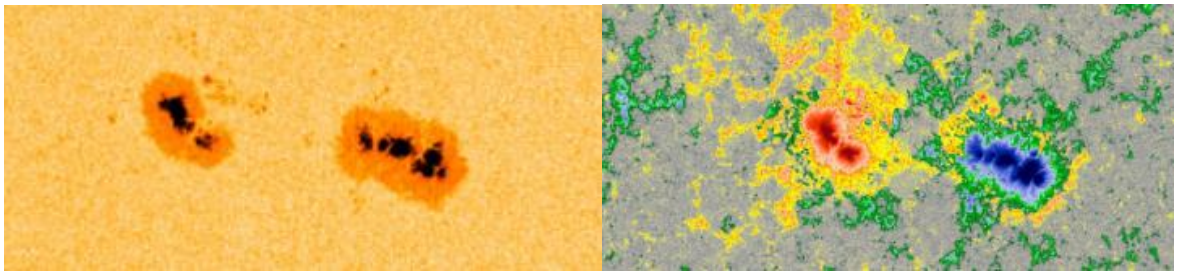
Radio Blackouts - X-Ray Flares:

Solar activity is expected to be Low or Very Low with only two significant, but relatively inactive sunspot regions on the visible disc. AR3141 (Eko/Beta-Gamma) is relatively complex but also appears to be stable, with AR3140 (Hsx/Alpha). The remaining regions are all weak, stable or inactive, and contribute little to the overall flare risk. Three returning active regions are due to rotate across the limb through the next few days, with a consequent increase in the risk of M-class flares.

Solar activity is expected to be mainly Low or Very Low, with slight but increasing chance of Moderate activity through the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: SDO HMI intensitygram imagery of AR3141 (Eko/Beta-Gamma)



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background levels and is forecast to generally remain at this level through the period. A very minor increase in proton storm probabilities is included towards 12 and 13 November as AR3141 moves into a more geoeffective position.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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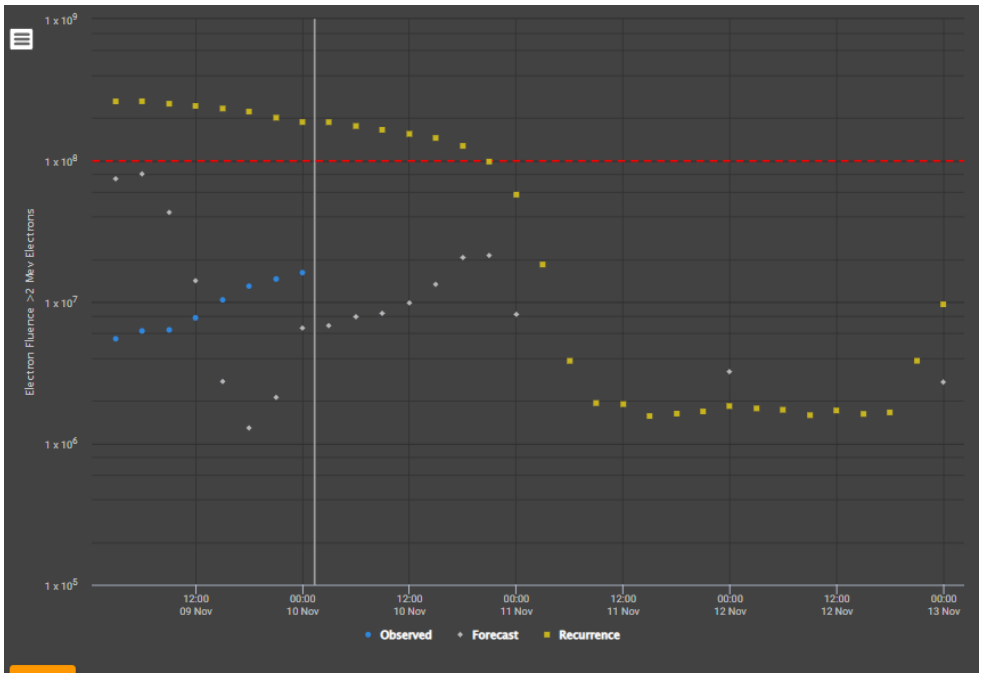
High Energy Electrons Event (≥ 2MeV):
Electron flux (greater than 2MeV) increased from background to moderate levels through the period. Electron belt modelling for the next 24 hours is showing a potential decrease in electron flux at GOES-16 with flux forecast to remain below the high (1e3 pfu) threshold. Although confidence is low for the remaining three days, given the uncertainty in weak coronal hole connection and subsequent high speed stream effects, electron flux levels are expected to remain below the high level, with only a low risk of reaching this level on diurnal peaks.

Electron fluence values are below the Active (1e8 integrated pfu) threshold. Although recent observations have shown a rising trend, fluence is expected to remain below the Active level.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM observations and model



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